On-Site Hog Farm Mortality and Birth-Related Tissue Composting Demonstration Project

General over view of the project

The purpose of this project, funded by, the Governor's Office of Energy Management and Conservation (OEMC), through a competitive solicitation was to demonstrate the feasibility of on-site composting of hog mortalities and birth-related tissues. Northeast Colorado Health Department (NCHD) received the funding for the project and worked with local partners to coordinate efforts. Staff from the Colorado State University Extension Office in Logan County, Colorado and the United States Natural Resources Conservation Service office in Sterling, Colorado were partners in the grant.

This project demonstrated the feasibility of on-site composting of hog mortalities and birth-related tissues. Variables monitored included (1) weight of mortalities, (2) amount of bulking material and water added, (3) temperatures of both outside air and composting pile, (4) moisture and (5) final compost components. Conducting this demonstration on the actual production site shared the actual impact to the operation itself.

In this project, baled tires were used for the sidewalls of the compost bins. Fourteen bins were constructed on two different large scale hog farms in Yuma County, Colorado. The bins were constructed on concrete pads to reduce the amount of leachate from the bins. Temperatures of both the composting material as well as the outside weather were monitored daily (except weekends and holidays) though the process. Originally, the bins were to be loaded in about ten days then allowed to set for forty-five days, be turned and set for another forty-five days to complete the composting process.

At Site 1 the piles were allowed to sit for 30 days, were turned and allowed to sit for another 30 days then turned and allowed to set for a third 30 days. At Site 2 the bins were filled and allowed to set for 45 days then turned and allowed to set for another 45 days as was originally proposed. Site 1 used a quicker turn process due to the large number of mortalities they had just as the project began.

Two commercial confined animal feeding operations participated in this project. The first farm to start(Site 1) had to deal with Porcine Reproductive and Respiratory Syndrome (PRRS) in the herd and the second coldest November on record for Colorado. The PRRS created a larger number of mortalities than was typically expected. The cold weather required an adjustment in the way the dead animals were handled. Because of the increased weight of dead animals the farm adjusted the timing of the composting process by filling the bin for five days, letting the compost pile set for thirty days, turning and setting for another thirty days then turning again and letting it set for thirty days. This reduced the total length in the process by five days. This site had previous experience with composting and were uncomfortable asking for technical assistance.

Pathogen samples were taken during the process to test for E. Coli., Salmonella, Actinobaccillus and Erysipelothrix. The compost was analyzed for nutrients at the end of the process. This analysis consisted of total nitrogen, organic nitrogen, ammonia, nitrate, phosphorus,

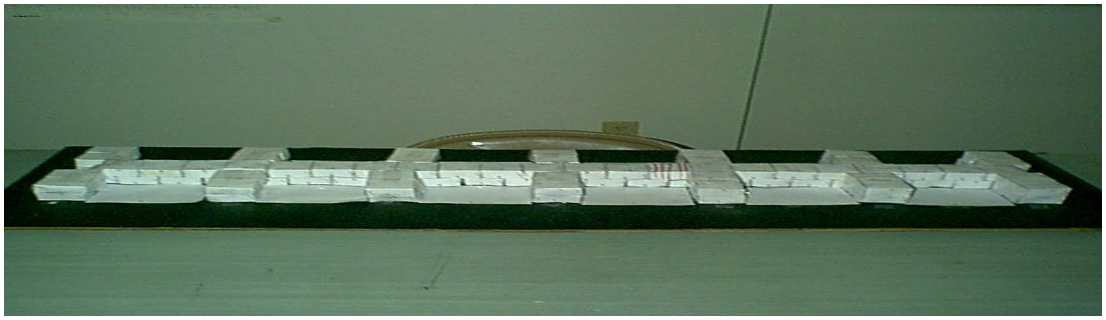
calcium, magnesium, sulfate, chloride, sodium, moisture, and organic matter, salts and C:N ratio. Laboratory analyses was conducted by both Colorado State University Diagnostic Laboratory and Olsen's Agricultural Laboratory. See Attachment #1.

Location of project

Yuma County, Colorado is located in the northeast part of Colorado. Colorado counties which border Yuma are Phillips to the north, Washington to the west and Kit Carson to the south. The eastern border of Yuma County connects with Dundy, County Nebraska and Cheyenne County, Kansas. The county seat in Yuma County is the town of Wray. Both sites used in the demonstration project are nearly 140 miles from Denver. The annual rainfall in Yuma County is about 14 inches. The soil in the area is sandy. Groundwater is generally more than 100 feet below the surface. Site 1 of the demonstration is located 10 miles south and 1.5 miles west of the town of Yuma; Site 2 is 7 miles east and 4 miles north of the town Yuma.

Design and Construction

The bins were sized using the model presented in the *Environmental Assurance Program* of the National Pork Producer Council.



The bins at Site 1 were 10' by 12' by 5' tall; at Site 2 they were 12' by 12' by 5' tall. The bins were calculated to handle 600 pounds per day. Both farms made the bins sloped with curbs on the back to contain as much of the leachate as possible. Site 2 used meshed reinforcement for added strength. The bins were built based on recommendations from the Natural Resources Conservation Service.

The sidewalls and back of the bins were made of tire bales. The bales measure 56” X 60” X 30” and are held together with 3/8-inch galvanized steel wire. The tires were obtained through a grant from the Department of Local Affairs, Division of Local Government. The Department administers the waste tire grant program for Colorado. There are four grant areas within the waste tire program. The grant used was the *End User Reimbursement*. This grant encourages “the use of recycled tires” and is available to “waste tire processors and end users who demonstrate the use to recycled tires”. Waste tires were used because it was a beneficial reuse of a resource that is in abundant supply. Also, as stated above, it was hoped the tires would provide insulation and radiant heat to the compost piles. Ultimately, they did not provide as much heating as was originally hoped.

Site 1 used straw bales for a small composting project before this project was started. The straw was not durable enough for long term composting. While used in the composting the bales lasted only about a

year. An advantage to the straw bales is that they provide some carbon to the compost as they deteriorate. Any baled stubble could be used in the composting either as a sidewall or in the compost itself as a carbon source, if they were available.

The straw bales also provided nesting areas for rodents. There is no evidence of rodents nesting in the tire bales during the demonstration project. The tire bales could last indefinitely. The weakest component of the bale is the baling wires. Bob Knecht, a professor with the Chemical Engineering and Petroleum Refining Department of Colorado School of Mines believes the baling wires could be cut on the lower bales without changing the structural soundness. It was believed that by cutting the wires the solar heat would encourage the bales to expand slightly and form a tighter seal to the outside. The Colorado School of Mines conducted their own activity of testing the structural soundness of the bales during this composting demonstration project. They collected data on 2 parameters – deflection and bale temperature. Preliminary data demonstrates that there is very little deflection. The tires move less than ¼ inch. The bale temperature tracked very closely with the outside temperature. The tires were consistently 30 degrees lower than the outside air temperature.

The sidewalls were made with tire bales obtained from Midway Tire Disposal/Recycling Inc. The bales are approximately 56” by 50” by 30” and contain about 100 tires each. The back wall was constructed in a brick-laid fashion staggering the second row over the bottom row. The sidewalls were stacked on top of each other. The interior of each bin was approximately 12’ wide and 5 feet tall. The bales were placed so as to reduce contact of the baling wires with the compost as much as possible. Tire bales were chosen as they were readily available, durable and had not been used in this fashion previously. Site 1 had used straw bales in the past and were anxious to try a more suitable sidewall.

Bin location

Bins at both sites, were located near the barns where the dead animals were grown. The bins at Site 1 were within ½ mile of the pig barns and 300 feet of their maintenance shop. At Site 2, the bins were constructed within 500 feet from the barns.

The bins were oriented generally so that half of the bins opened to the north and the other half opened to the south. The bins situated toward the north typically had lower composting pile temperatures during the winter months. The intent was that in the winter the dark tires would help retain heat from solar radiation during the day. This did not seem to help as much as was originally hoped.

Stockpiles

Extra tire bales were used to create stockpile areas for the bulking materials. Additional areas for stockpiling the completed compost were not designated as part of this project.

Economic feasibility

One of the main objectives of this grant was to determine the energy savings of composting versus traditional rendering. Most commercial hog farms are currently transporting and paying for the dead animals to be rendered. On-site composting will not reduce labor costs but it will reduce the energy costs associated with transport of the dead animals to the renderer and save the cost of rendering as well as the energy consumed in the rendering process.

Composting vs. other methods (rendering, landfill, burial)

Practicality

Before participating in this demonstration project, the farms were paying to have their animals rendered plus transporting them to the renderer. This is a costly activity. Additionally, with the current situation in the world concerning Foot and Mouth Disease and Mad Cow Disease the market for rendered meat may be reduced in the future. Therefore other means of dead animal disposal are being explored.

Animal mortality disposal in landfills is not wide spread. Most public landfills will not accept large animals and if they do a separate charge is accessed.

Burial of hog mortalities is generally perceived as a poor choice for disposal. In the past, whenever a commercial facility has buried their mortalities, the Northeast Colorado Health Department has received numerous citizen complaints. People are concerned about water contamination, as all of the drinking water in Northeast Colorado comes from ground water. Depending on the outside air temperature at different times of the year, odors can also be a concern.

In order to incinerate the mortalities, confined animal feeding operations would have to obtain an Air Quality permit from the Colorado Department of Public Health & Environment. Incineration costs include the cost of the equipment, the fuel source and permitting fees. An Air Quality permit modification would be required if an existing permitted hog facility changes to incineration from the current operation.

Energy efficiency

Composting does reduce travel to the renderer. The cost could be marginally reduced if composting is done at each barn rather than at a central location. Some confined animal feeding operations spread their barns out over a large distance to control the movement of disease. A central site for these type operations might be several miles apart. The rendering process is a very energy intensive act, which necessitates the high costs to the farms for rendering.

Transportation to renderer

The nearest renderer is located nearly 75 miles away from the sites in Fort Morgan, CO. The farms had been transporting the mortalities to the renderer in hog farm trucks in an effort to reduce their expense. The current customary charge for semi-trucks is $2.00 per mile. Using this figure the cost of a round trip is $300.00. Mortalities are transported seven days a week, every week. The cost of transport is approximately $109,500.00 per year for each truck making the trip. The rendering operation in Fort Morgan does not process the dead animals; they sell them to a company in Denver. This cost is not included in this analysis.

The farms were paying $0.03 per pound to render all their mortalities. The total loss per day for these farms is 7,500 pounds for each farm. The cost of rendering is $225.00 per day for $82,125.00 per year for each farm. The fee for rendering would decrease to $0.015 when they were only rendering their large (over 100 pounds each) mortalities. Rendering and transport costs are $191,625.00 per year per farm.

Environmental benefits

The compost produced during this project would provide some nutrients for crops grown on the land where it is applied. The larger environmental benefit will result from the added organic material in the soil. The majority of the compost produced during this demonstration was used for cover material for the additional composting bins being constructed. This was done in order to discourage coyotes from feeding off the bins.

Bulking agents used

For this project, wood chips, bedding and straw were used for the bulking agents. The bulking materials were not mixed together for ease of handling and were used individually in layers on the piles. Some piles may have used more than one type of bulking material, depending on what was readily available, but the materials were seldom mixed.

Much of the wood chips used were obtained from the Logan County landfill, which has a program to produce wood chips from downed trees. Wood chips were not readily available in Yuma County. The average cost for wood chips is $250 per 25 cubic yard.

The available straw was in big loaf bales which weigh 2 to 4 tons and needed to be ground up to be adequately mixed. Straw is abundant in Yuma County. There is not always available willing contractors to bale the straw. Straw, when purchased is currently priced at $40 to $50 per ton plus delivery and grinding.

A procedure was developed for the compost pile building and used at each Site. See attachment # 2.

About 12 inches of bulking material was placed in the bottom of each bin to absorb liquids in the pile. One layer of up to 8 inches of dead hogs was added next. The hogs were placed at least 12 inches from all sides of the bins and covered with 12 inches of bulking agent. Before each layer of hogs was added, about 6 inches of bulking material was removed from the cover of the pile to fully utilize each bin. Then the hogs were placed as before. This was repeated until the piles were about five and a half feet tall.

At the end of each full process samples were taken to test for nutrients in the compost. The piles were sampled for pathogens every two weeks during the process.

Mortality condition and age

Site 1 started using nursery- pig sized mortalities, many of which were greater than 20 pounds. The dead animals used were removed from the barns the night before they were to be placed on the piles. This site started in November 2000 and the temperatures were cold. The average mean temperature for that month in Yuma County was 30.9 degrees.

The hogs added to the piles were frozen as they were kept outside the night before they were placed in the compost bins. The bulking agent was also cold when added to the bin. All of these factors contributed to an unworkable condition to begin a successful composting procedure.

Site 2 started in February, 2001. They used smaller pigs (up to 20 pounds) and after-birth and placenta. The after-birth and placenta provided water and bacteria for the process. They also used water from the lagoons rather than fresh water to start the process.

Carbon sources

Site 1 began the process using the bedding material that had been used in the transport trailers for the first layer in the bins. There was sufficient quantity of this material to use for the bottom layer in the bins. Wood chips were the carbon source for the composting. This site had an immediate need for a larger quantity of wood chips than anticipated because of the larger than planned number of mortalities.

Site 2 used wood chips for the carbon source as well as the bulking material. The wood chips for this site were too large to hold moisture in contact with the composting material. The piles at Site 2 were continually less than the desired 45% to 65% moisture. Lagoon water was needed for the added moisture.

Stockpile locations

The materials were stockpiled close to the composting site for ease of operation. The finished material was also stockpiled at the site before being used for beneficial purposes.

Finished compost

All of the finished compost from this demonstration was either used for cover in new composting piles or given to area farmers for land application. In Yuma County, there is not a ready market to sell the compost. The Colorado State University Cooperative Extension reviewed the laboratory analysis and recommended using it to treat iron chlorosis or to help stabilize sand blowouts and promote crop growth or grass cover. They determined the value of the compost to be about $2.94 per ton if a buyer were found. See Attachment #3.

Compliance with Federal, State and Local environmental and composting regulations

The Colorado Department of Public Health and Environment (CDPHE), Hazardous Materials and Waste Management (HMWM) Division, has developed composting regulations. Section 14.1.2 of these regulations state that "(B) Agricultural composting if: (i) compost materials are derived from on-site agricultural activities by the generator only; and (ii) the facility only imports other compatible materials in quantities necessary for effective composting as part of a standard agriculture practice; and (iii) composting activities that occur at the site of generation or contiguous property owned or leased by the generator..." are exempt from regulation. Therefore, if the operation is composting materials generated at the farm there are no regulations governing the process. If an environmental problem arises CDPHE would stop the composting based on the environmental issue and not, per se, on the composting issue.

Mortalities that are composted at a site not contiguous with the site of generation is considered a Class III operation and requires an operation plan be filed with the Hazardous Materials and Waste Management Division (HMWM) of the Colorado Department of Public Health and Environment(CDPHE). Any site that has more than 50,000 cubic yards of material on site must have a Certificate of Designation from the HMWM Division.

Any change of operation with regard to the Swine Waste Management Plan of the Housed Commercial Swine Feeding Operations requires notification to the (CDPHE), Water Quality Division.

No Local regulations other than State

Currently there are not any composting regulations adopted by local boards in Northeast Colorado. Entities that receive special use permits from their counties, may have specific requirements. The sites that participated in this composting demonstration did not have any additional composting requirements as part of their special use permit issued by the Yuma County Commissioners.

Lessons learned

People make the Difference

As with most any project, having good people dedicated to the project is important. Composting is a seven day a week job and needs people who will give it attention daily. It may be necessary to compensate the compost pile manager better than normal to help insure a successful project. The personnel at Site 1 changed throughout the process, while Site 2 had consistent dedicated people.

Don’t use frozen ingredients

Site 1 began by using frozen “bucket” pigs. These are animals that are small enough to fit in a five-gallon bucket

The pigs were frozen because the process was to remove them from the barns late in the day and leave them outside for pickup in the morning. The overnight temperatures were in the teens to below zero for most of November and December. The frozen pigs prevented any decomposition to occur. Once this problem was identified the buckets were stored in the hall inside of the barns. This kept the pigs from freezing. Frozen carbon sources could also cause this problem & should be avoided.

Whole baby pigs don't have enough microbial action to get compost process started.

Site 1 used just the nursery pigs and fresh water with the wood chips. The temperatures did not rise as expected even after the frozen pig problem was corrected. They added manure from a nearby dairy and the temperatures began to rise. This showed that the little whole pigs did not have enough microbial action in their systems to get the composting process started. Larger pigs would need to be split open to allow the process to begin.

Lagoon water helps

Site 1 made a tank to pump water from the lagoon or the pit in the barn to use on the pile. This helped their temperatures rise later in the project.

Site 2 used water from their lagoons to start the piles. This combined with the after-birth and placenta provided enough bacteria to get the compost started. Site 2 used fresh water after the bin was fully loaded.

At both Sites, the moisture in the bins were not kept high enough to compost optimally. Future bins should be soaked thoroughly and moisture checked daily and added as needed.

Overloading hurts

The bins were designed to accept 600 pounds per day. As site 1 began the project they experienced an outbreak of PRRS. Their quantity of hog mortalities increased dramatically because of this disease outbreak. The original plan was to load for 10 days, set for 45, turn and set for another 45. Because of the PRRS, site 1 modified it to fill in 5 days set for 30, turn and set for 30 then turn and set for 30. It is not known if this time line caused any problems with the final product as the bins were over loaded from the beginning. The final compost at site 1 has several bones in it (picture). Good final compost should little evidence of the individual components.

Carbon source needs to be sized appropriately

If wood chips are used as the carbon source, they should be no larger than 1/2 inch square and there needs to be 15” placed on the bottom of the bin before mortalities are added. There also needs to be 15” of wood chips between each layer of pigs and 20” used for the cover on top.

At times larger wood chips were used and allowed water and applied effluent to drain rapidly through the pile, instead of being retained in the composting pile. Securing wood chips of the size needed proved to be nearly impossible.

A Cap serves many purposes

The cap needs to slant toward the outside of the bins, thereby shedding precipitation to the outside of the bins. A cap also helps keep out coyotes. There was a significant problem with coyotes and possibly other vectors at Site 1. The cap and buffer material between the bin sides and front needs to be thick enough, at least 15 to 24 inches to deter wildlife from using the composting pile as a nourishment source.

Capital Costs can be recouped quickly

The capital outlay needed at each site would be less than $15,000 to construct the composting bins. Savings generated from reduced rendering expenses offset this investment in a matter of months. Site 2 had estimated that their breakeven point was when they were composting 1,377 pounds of farrowing mortalities and by-products a day. They were actually producing 2,500 pounds of mortalities and farrowing by-products each day.

Geography makes a Difference

The bins were sized and sited according to a model of the National Pork Producer Council. There are places in the United States that such a model would work well. Unfortunatly, the plains of Colorado proved to be a site note conducive to bins being opened to the North. The relatively small size of the bins seemed to inhibit sufficient composting action from occurring.

Wildlife can disrupt the process

Any composting project began in rural parts of the state need to be prepared for wildlife interest. Coyotes were a significant issue at Site 1. The bins were not loaded properly to prevent pig body parts from being exposed to the outside which was an open invitation to coyotes. This also could have caused an odor issue had it occurred at a warmer time of year. The bins need to have a large enough buffer and cap to encourage the composting process to begin. Once this has occurred, coyotes will be discouraged by the heat coming off the piles.

Appendix

Tables of temperatures and moisture
- Central Plains data Attachment #4
- Alliance Farms data Attachment #5

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